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*To Professor W Kendrick
With Compliments*

A DETACHED LEFT OCCIPITAL LOBE

*948. — 1882

AND OTHER ABNORMALITIES IN THE

BRAIN OF A HYDROCEPHALIC IMBECILE.


BY A. CAMPBELL CLARK, M.B.,

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Fig. 1



Fig 2

Fig. 3

A DETACHED LEFT OCCIPITAL LOBE
AND OTHER ABNORMALITIES
IN THE BRAIN OF A HYDROCEPHALIC IMBECILE.

By A. CAMPBELL CLARK, M.B.

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(This paper was read, and the microscopic appearances were shewn, at the Quarterly meeting of the Medico-Psychological Association, in Edinburgh, on 14th Nov., 1878, and the Intra-gyral Association system was microscopically demonstrated at the meeting of the Association, in Glasgow, on 26th March, 1879.)

John R., admitted into the Melrose Asylum on the 29th May, 1875, æt. 38.

The history of the case is, that he was one of the illegitimate children of a drunken woman, in whose custody he was allowed to remain, until one of the Commissioners in Lunacy interfered, and ordered his committal to the Asylum; and the feeling then was that this interference had not been exercised an hour too soon, for he presented an appearance of dirt and general neglect, surpassing anything that, in the experience of Dr. Grierson, the Superintendent, had ever been witnessed since the opening of the Asylum.

The following facts regarding his early history were ascertained: (a) that he was born hydrocephalic; (b) that the hemiplegia, from which he suffered, was pronounced by the late Professor Syme to be congenital; (c) that there is no history of syphilis in the mother.

The physical conditions were essentially those of deformity and extreme helplessness. Incapable of progression in the ordinary manner, he had been accustomed to move about for short distances of a few yards on all fours, and while in the Asylum required to be carried about from place to place.

The head attracted attention from the large cranium and small face, the frontal bone being very prominent in the region

of its eminences, and large in its vertical direction, and the cranium generally being of considerable size. In the left spheno-temporal region there was a very decided oval swelling, of the size of a hen's egg, projecting outwards. It was hard to the feel, and marked in its definition from the rest of the cranium. Looked at from above, the contour of the circumference of the head was irregular and asymmetrical, and the left semi-circumference seemed larger than the right. The face was small for his age, the features were fine and regular, and the expression usually happy and pleasant, though childish. The palate was saddle-shaped, and the pommel well-marked. There were no molars in the lower jaw, and only one in the upper (left half). There were no canines or bicuspid in the upper jaw.

As regards the nervous system, the following facts were noted :

Sensory Functions.—The ordinary sensation of the right side was said to be impaired.

Motor Functions.—He suffered from right hemiplegia. The chief paralysis observed in the arm affected the muscles of the fore-arm, and those which elevate at the shoulder joint. He was never observed to move the right lower limb in any way, and it appeared to be a drag on the left, which alone was observed to execute movements. When placed on a chair the left hip appeared to adapt itself to his altered position more readily and naturally than the right. Lastly, there was convergent strabismus of the right eye.

Reflex Functions.—Normal.

Special Senses.—Sight myopic. Hearing and taste normal.

Mental Functions.—A study of his mental state showed that it was more negative than positive in its characters, but negative only to this extent, that mental processes of which he was capable indicated more an arrested development of most of the mind faculties half-way, than perversion or utter defect. The best developed faculty was certainly that of memory, which in his case was exceedingly impressionable and retentive, and the most exaggerated faculty was the emotion of fear. As with a boy of 10 or 12 years, his mental power and vision were limited to the observations of trivial matters of childish importance, which he took account of chiefly as they concerned himself, thus wanting that deeper observation and more mature reflection, which exist in the adult of ordinary intelligence. He could not take a wide view of human relations and interests, or appreciate the

graver questions of every day life. With his senses fairly developed—the eyesight only being affected—he was capable of experiencing many and varied impressions, and these generated corresponding ideas simple and complex. He was capable of associating ideas, and his ready memory here came into play as a prominent factor, but want of education and his helpless condition (which necessarily excluded him from participating in many outdoor experiences) deprived him of many ideas associated usually with an ordinary adult intelligence. This, combined with feeble volitional energy, rendered him helpless in constructing or following the more complicated processes of mentalisation of the ordinary kind. He was very observant, showed a fair appreciation of his surroundings, and displayed an amount and character of curiosity something more than childish. He could not read, simply because he had never been taught, not because he wanted memory, or a fair share of comprehensive power, for he possessed both. His memory, in fact, was remarkable. He remembered having once or twice in Edinburgh been lifted off the streets as a nuisance thirty years previously, and delighted in describing the prison scenes which came under his observation. Frequently conversing with acquaintances hailing from a town where he had spent the greater part of his life, it was his wont to bring to their recollection events of as far back as twenty years before, *e.g.*, incidents connected with marriages, fairs, &c.

Although the patient could not read, he had learned many Bible facts, and understood in a general way the laws of Scripture teaching. The moral sense was fairly developed. He often expressed regret regarding the behaviour of his mother, whose looseness of moral character was well-known in the district, and did not fail to strike his observation. He was not slow of comprehending simple matters, and showed a wonderful appreciation of any joke which he could understand. The relative powers and positions of officials who came in his way were quite understood by him, and he was cunning enough to make the best of his acquaintance with the more important members of the staff. Alive to the failings of attendants, he has been known to threaten to report a slip on the part of one of them, when the latter had occasion to perform a duty painful to him, but the general tone of his manner was conciliating and amicable. He had musical talent in a fair degree, readily recognised the more familiar tunes when whistled or sung, and though he himself whistled indifferently

he could, nevertheless, give forth, in rough fashion, a tune, so as to be recognisable. The emotion of fear, as already observed, was very strongly marked, this emotion, believed to be the lowest of its class, was, when excited in him, quite beyond the control of his will, and no amount of experience could rid him of it, or lessen its intensity. Thunder was a great terror to him, and its first peal was the signal for covering himself over with the bedclothes. Patient had also a dreadful horror of a bath, and, notwithstanding the frequency with which ablution had been resorted to during his residence in the Asylum, his nervous aversion to it was as strong at the end as at the beginning. When placed in an arm-chair, though protected all round, he was in a state of deplorable misery, until he was brought back to bed, so great was his fear of falling. His speech, as regards co-ordination and articulation, was normal, but the tone was feeble and his mode of expressing himself simple and childish. His mother had developed in him a liking for whisky, and in his last illness the thirst for it was peculiarly prominent.

Subsequent History.—As far as concerns the mental state of R., nothing noteworthy came under observation latterly. The only conditions attracting observation were of a physical character. In 1877 chronic peritonitis was diagnosed, and on the 18th October, 1878, the illness which terminated in death was ushered in by vomiting severe and persistent. This distressing symptom was present at varying intervals till 6 p.m. of the 22nd, when he became suddenly comatose, and examination of the eyes revealed convergent strabismus of the left eye, in addition to the pre-existing right convergent strabismus, which still remained. He died at 5.30 p.m.

Record of Post-Mortem Examination made 52 hours after death :—

Height 4ft. 6in. Circumference in plane of nipples $29\frac{3}{4}$ inches.
Measurements of head—

(a) Tragus to middle of forehead	{ Left . . .	$6\frac{1}{2}$ inches.
	{ Right . . .	6 "
(b) Tragus to occipital protuberance	{ Left . . .	7 "
	{ Right . . .	$6\frac{1}{2}$ "
(c) Occipital protuberance to glabella	. . .	14 "
(d) Mastoid process to mastoid	. . .	$14\frac{1}{2}$ "
(e) Circumference in plane of occipital protuberance and frontal eminences	. . .	$24\frac{1}{2}$ "
(f) Right semi-circumference	. . .	12 "
Left " "	. . .	$12\frac{1}{2}$ "

External Appearances.—Convergent strabismus of both eyes. Lips and gums extremely anæmic. Feet flat soled. Right leg and thigh smaller than left; the legs semi-flexed on thighs, and thighs semi-flexed on abdomen, particularly the right, in which the ham-strings are very tightly drawn and prominent. The condyles of right femur are larger proportionately than those of left. Both lower limbs tend to lie to the right side. The right arm is not so well developed as the left, the development of which corresponds to the general fair development of the body; there is complete flexion of right hand.

Examination of the Cranium.—The right frontal bone is considerably bulged outwards. Slight bulging in neighbourhood of left frontal eminence. Distinct flattening is observed in the region corresponding to the anterior fontanelle, which is completely ossified. As regards the parietal bones, there is on the left side an uniform increase of the natural convexity; whereas on the right, between the sagittal suture and right parietal eminence, the bone is flattened, and the right parietal eminence juts out abruptly about an inch below the sagittal suture, and therefrom downwards shows well-marked convexity. On the left side the upper part of the occipital bone bulges considerably backwards and to the left. It will thus be noted that the longest diameter is in a line extending obliquely from left to right (left oblique diameter), the extremities of which indicate the points of greatest convexity. The sutures are all closed, and firmly ossified.

Relative Thickness of Cranial Bones.—Left frontal fully twice as thick as right. Temporals about equal, but very thin, almost papery. The parietals appear to be natural. Occipital at least not less than normal. The groove for the superior longitudinal sinus is replaced in its anterior half by a prominent bony ridge, which, on reaching the vertex, leaves the middle line, and in its course backwards diverges gradually more and more to the right, and ultimately reaches the posterior margin of the foramen magnum. The various diameters and their measurements are given in Fig. 1 (which is an impression printed from a section of the cranium and reduced one half). On examination of the base and of the inner aspect of the cranium generally, it is found (*a*), as regards the fossæ, that there is want of symmetry; that this depends upon well pronounced expansion of certain fossæ, and that the fossæ so expanded

correspond to the areas of greatest expansion on the skull cap. The fossæ in question are the right anterior, left middle, and left posterior. At the same time, the relative increase in the left posterior is not in proportion to the corresponding expansion of the skull cap; but this may be accounted for by reference to the firmly interposed tentorium, and the subjacent cerebellum. (b) As regards the vascular channels, that there is no torcular Herophili; and that the only sinus represented in the posterior fossæ is the right lateral. Further, the left middle meningeal groove is considerably larger than the right; (c) that the right lateral sinus begins immediately at the right side of the ridge above-mentioned, which appears to do duty for the anatomical middle line.

Examination of the Brain and its Membranes.—On the right side, comprising the whole superficial extent of the hemisphere, was found a large cyst containing clear serum. The cyst wall, with the exception of a part of the floor, was formed by the arachnoid, which was greatly thickened. The latter did not spread over the basilar portion of the hemisphere, but had resolved itself into two layers, the more extensive and upper one forming the superior and outer walls of the cyst, the lower covering the pia mater on the upper surface of the hemisphere, except in the centre of the floor, where the lateral ventricle was found freely exposed; and a narrow strip of convolution, bounding the ventricle anteriorly and posteriorly, was also free from interposition of arachnoid. Organised bands of fibrous tissue traversed between the walls of the cyst in various directions. Its estimated capacity was 16 fluid ounces. The dura mater over it was closely apposed. On the left side, covering the upper and outer aspect of the frontal lobe, was found a cyst as large as a medium sized orange, the walls of it being formed by the arachnoid—greatly thickened, opaque, and bladder-like—and with dura mater over it in close contact to the cyst wall, but not so thick as the arachnoid. On opening this, it was found to contain serum coloured by blood of recent effusion, and a fibrinous clot in the floor.

Enclosed in the anterior part of the falx cerebri was found an elongated piece of bone $1\frac{1}{2}$ inch in length, which lay above and to the right of cyst last described. In the region of the last, as in the first mentioned cyst, the arachnoid was found wanting at the base of the hemisphere. One more cyst remains to be described. It covered the left hemisphere

on its upper and outer aspect, and filled up many gaps and deficiencies in the hemispherical structure. This left posterior cyst was the largest of the three, and its estimated capacity was 20 ounces. It contained, like the cyst on the right side, clear serum. The upper and outer walls were formed also by the thickened arachnoid, the dura mater being in firm contact with it—the floor by the base of a pyramidal shaped portion of brain substance which apparently had no nerve connection with the rest of the brain (this lobe corresponds to the left occipital, and will be referred to more particularly later on), and also by the left lateral ventricle, and the intermediate tentorium cerebelli. The pia mater was found thickened, and adherent to the cortical substance as follows:—(a) Right marginal convolutions, slightly at more than one point; (b) right gyrus fornicatus, slightly anterior to its centre; (c) left supra-marginal convolution.

The medulla oblongata shows well-marked convexity on the posterior aspect, and is flattened on the anterior surface. The fourth ventricle is small; and the aqueduct of Sylvius cannot be traced. The right crus cerebri is about twice as thick as the left, and in the latter the crura and tegmentum are correspondingly diminished; and the locus niger on both sides is large, but relatively and virtually larger on the left side, where it is diffuse in appearance, not presenting the typical crescentic form, which was well seen in the right. The peduncles of the cerebellum appear of equal size.

Right Hemisphere.—The convolutions and sulci show a very fair degree of development. The convolutions are delicately elaborated, the secondary sulci being numerous. The normal convexity of the upper and outer surface of the hemisphere is wanting anteriorly, owing to the lateral ventricle being freely exposed, and to partial destruction of the upper portion of frontal lobe. Ventricle oval-shaped and $1\frac{3}{8}$ inch long. Corpus striatum, optic thalamus, and tænia semi-circularis are small, but still correspond with the size of the hemisphere. The ventricle has a very contracted appearance, owing to adventitious bands of fibrous tissue which arch over the commencement of the anterior horn, and over the whole of an accidental transverse horn, the channels of which are therefore rigid and constricted. The cornua are found as follows:—Anterior terminating very abruptly, being only an eighth of an inch long; inferior appears to be natural; there is no posterior, but instead is found a horn

which has a direction properly speaking transverse, and directly outwards and ultimately backwards, its groove marking a wide separation between the middle frontal, inferior frontal convolution, and anterior part of the operculum, on the one hand; and the lower extremities of the ascending parietal and ascending frontal convolutions, on the other. This groove is roofed over in the whole of its extent by a covering of fibrous tissue, thus forming a closed channel.

Convolutions and Sulci.—In the region corresponding to the floor, and anterior portion of right cyst, there is a considerable deficiency of brain substance. The superior frontal convolution is wanting to the extent of three-fourths—the posterior fourth alone remains; and presents at the point of solution of continuity a raggedness and irregularity of surface, indicative more of tearing than gradual disintegration. The middle frontal has also been broken in upon; but at its posterior extremity, the portion of its substance wanting being the posterior fourth; and its posterior free edge (the point of solution of continuity) is smooth, and has evidently entered into the formation of part of the incidental transverse horn already described. The only defect in the inferior frontal is a slight grooving corresponding to the point where the transverse horn curves backwards. The ascending frontal appears short, and it, together with the ascending parietal, appears rather defective inferiorly, the transverse cornu in its backward course intervening between these convolutions and the operculum. On section of the ascending frontal convolution, the inferior cornu was seen to run deeply beneath it. The parietal lobe has developed in rather irregular fashion. Nothing particular falls to be noticed concerning the ascending parietal and supra marginal convolutions; but the remaining convolutions of the parietal lobe are represented by a series of vertical gyri—four in number—which are mainly situated between the ascending parietal convolutions and the occipital lobe. They all run downwards from a narrow strip of brain substance which skirts the longitudinal fissure, and their directions are parallel. The first from before backwards is the shortest, and runs into the supra marginal convolution; the second joins by annectent gyri with the superior and middle temporo-sphenoidal convolutions; the third becomes continuous with the middle temporo-sphenoidal; and the fourth, and most posterior one, communicates with the superior occipital convolution by the first annectent gyrus which embraces and limits the outer

extremity of the parieto-occipital fissure; lower down this fourth convolution blends with two annectent gyri from the middle occipital; and at its inferior extremity it is seen to run into and fuse with the third vertical convolution already described.

As regards the occipital lobe, all that requires record is the arrangement of the convolutions on the inner surface. The occipital lobule is somewhat coarse in outline, and feebly differentiated into secondary sulci; and it is separated from the parieto-occipital fissure by what must be considered an accessory and incidental gyrus. Inferior to these the convolutions show little conformation to the normal type. The apex of the lobe is very prominent and pointed. The condition of the temporo-sphenoidal lobe presents nothing striking. There is deficiency of the gyrus fornicatus and marginal convolutions corresponding to the region of destruction already described, and thus is formed a complete transverse gap, of irregular wedge shape, the base being at the inner aspect of the hemisphere. The Island of Reil is well developed, and large for the size of the hemisphere.

Fissures.—Sylvian natural; intra-parietal wanting; parieto-occipital three-quarters of an inch externally, internally it forms a very oblique angle with the calcarine, which terminates in a small gyrus on a deeper plane, and this bridging gyrus overlaps the posterior portion of the optic thalamus. Below the parallel fissure there runs another fissure in a direction parallel with the former, but of much greater extent. This abnormal cleft is bounded above by the third and fourth vertical convolutions and by the middle temporo-sphenoidal, and below by the inferior occipital and the inferior temporo-sphenoidal. On drawing aside the edges about its middle, it is seen to communicate freely with the descending corner of the lateral ventricle.

Left Hemisphere.—On the left side there is not only evidence of breaking down of brain tissue, but also of considerable defect in the development of the hemisphere. Beginning again with the lateral ventricle, we observe that it is also exposed, but that a thin layer of white brain matter covers its middle and posterior parts. The corpus striatum is relatively large, and softer considerably than on the right side. It presents a grey gelatinous appearance, and fuses with the brain substance external to it in rather an abrupt manner. The optic thalamus is much smaller than the right, indeed almost rudimentary. Anterior cornu ends abruptly at about the same distance from the ventricle as on the right side.

The inferior in the backward part of its course is shorter than the right, and dips downwards very abruptly. On this side also the posterior horn is wanting, but there exists a transverse which is channelled through brain substance, and completely closed in; its length is one inch, and it is more capacious than the right transverse. Ventricle shorter antero-posteriorly, but with a greater transverse diameter than right. Foramen of Monro is patent on both sides, but exceptionally large on the right.

Convolution and Sulci.—These are chiefly frontal and parietal. They are not so well defined, nor so elaborately developed as on the right side; and therefore are more removed from the typical condition. Transverse frontals are moderately developed, but shorter than the right; and the horizontal terraced characters are not so well brought out. The ascending frontal and parietal gyri merge into one at their upper extremities owing to the rudimentary condition of the fissure of Rolando; they are narrow and short, entirely destitute of secondary sulci, and extend only half-way from the sylvian to the longitudinal fissure. The parietal lobule is defective posteriorly, for it slopes backwards and downwards to the supra-marginal in such a way that the latter forms the superior posterior angle of the hemisphere. As regards the temporo-sphenoidal lobe, all that requires remark is that the superior gyrus is present, the inferior wanting (except a nodule at the anterior extremity) and that there exists (corresponding to the middle gyrus) an elongated mass of brain matter which shows little or no differentiation into secondary sulci, but presents evidence of a disintegrating process along its whole surface. The operculum is present as on the right side. Supra-marginal twice the size of right, but the reverse obtains with regard to the Island of Reil, which, on the left side, is represented by a sunken area of white substance totally devoid of sulci or gyri. There is loss of substance on the inner aspect of the hemisphere corresponding to the defects on the outer aspect, and notably of the quadrate lobule and the posterior extremity of the gyrus fornicatus. The characters there are so blurred that I have not attempted a more precise description.

Detached Occipital Lobe.—Lastly, there falls to be noted the most remarkable of all the peculiarities, viz., a detached occipital lobe. This curious condition was observed on evacuation of the contents of the left posterior cyst, and the lobe was seen to be connected to the temporo-sphenoidal, merely

by a process of pia mater, along which was conducted its sole vascular supply. There is complete absence of nerve connection with the rest of the hemisphere, the only possibility of such, even in the faintest degree, being by microscopic fibres in the process of pia mater already described. Even assuming this, there is no real association such as could, even in the remotest degree, have connected it functionally with the rest of the hemisphere. Its shape, as previously stated, is pyramidal, the base of the pyramid is covered by thickened arachnoid, and formed part of the floor of the cyst. This lobe could only have reached a very early stage of development, for it is small in size, the convolutions are very simple and narrow, the sulci unbranched and shallow, the characteristic land marks of the more fully developed lobe are wanting, and the general appearance corresponds to what we would expect to see in the brain of a foetus. Further, the absence of organic connection implies absence of function, and in this way we probably have a satisfactory explanation of arrested development.

The third ventricle has a narrow contracted appearance, the anterior commissure being small, but the posterior and middle can scarcely be said to exist. Fornix and velum interpositum are present, but the pineal gland and the aqueduct of Sylvius are wanting. Corpora quadrigemina are small, and the differentiation into four tubercles scarcely observable.

Fissures.—(a) Fissure of Rolando reaches only half way upwards towards the longitudinal, and a very slender connection between the ascending frontal and parietal convolutions inferiorly saves it from freely opening into the sylvian fissure; (b) the latter is much better developed on the outer aspect than at the base, the ascending and horizontal limbs exist, the former crossing obliquely the inferior extremity of the fissure of Rolando, and running up behind it. A small annectent gyrus connects the anterior extremity of the superior tempero-sphenoidal with the posterior extremity of the inferior frontal.

WEIGHTS OF VARIOUS PARTS.

Right Hemisphere	.	.	.	.	.	13 $\frac{1}{4}$ ounces.
Left	.	.	.	.	.	6 $\frac{1}{2}$ „
Medulla, Pons and Cerebellum	.	.	.	.	.	5 $\frac{1}{4}$ „
						—
Total	.	.	.	.	.	25 „
Weight of Membranes.	.	.	.	.	.	2 $\frac{3}{4}$ „

THORACIC ORGANS.

Heart.—Weighed $7\frac{1}{2}$ ounces. Cardiac muscle healthy, valves competent.

Lungs.—Left: Extensive pleuritic adhesion; lower lobe shows passive congestion. Weight $13\frac{1}{2}$ ounces.

Right: Only adherent at apex; upper lobe somewhat emphysematous; lower shows passive congestion. Weight $12\frac{3}{4}$ ounces.

Abdominal Organs showed nothing special. The cavity contained a large amount of serum, with numerous flakes of purulent lymph. Peritoneum congested. Weights: Liver, 1 pound 14 ounces; spleen, $7\frac{1}{2}$ ounces; kidneys, right, $2\frac{3}{4}$ ounces; left, $3\frac{1}{4}$ ounces.

Microscopic Examination.—The following parts of the brain were examined microscopically:—(a) Occipital lobes; (b) Ascending frontals and ascending parietals; (c) medulla oblongata.

(a) *Left-Occipital or Detached Lobe*.—Prior to sections being made for microscopic purposes the grey matter was measured, and gave a depth of which the average is $1\frac{1}{4}$ millimetre, the greatest thickness of the lobe (*i.e.*, from apex of pyramid to base) being 11 millimetres. The sulci are very simple, there being no secondary sulci apparent on section. The cells of the grey matter are well defined, and the nuclei and nucleoli are in many of them quite apparent. No evidence of degeneration in any of the cells. They are of various shapes, round and large oval cells being most numerous, pyriform and pyramidal fewer, and arranged in no definite manner, the apices being superior, inferior, or transverse, and the cells forming no distinct layer. There are few processes, and these short and abrupt. The white matter appears almost natural. The only pathological conditions observed were a few clusters of corpora amylacea, both in the white and grey matter; and small pigmentary deposits, probably the remains of old hæmorrhages. These were scattered throughout the grey and white matter. A point of considerable interest is, that this remarkable lobe demonstrated, within a single convolution, a series of ganglionic centres with bundles of nerve fibres connecting them, and examination of a number of sections showed that this arrangement extends throughout the grey matter.

Fig. 2 represents the appearance seen in a section placed under a low power. At the point of demarcation between the white and grey matter, there exists a looped arrangement of bundles of fibres passing from one centre to another. While the great mass are intra-gyral,

two bundles are seen curving beneath a sulcus. The loops are not all in the same plane, for two bands are found passing more deeply into the grey matter, and their loops lie in different relations, one being horizontal and higher, the other more oblique.

Fig. 3 represents the same section under a high power, demonstrates the centre to be a group of large cells of various shapes, chiefly ovoid, and the fibres to be nerve fibres.

A third section, stained with chloride of gold, and placed under a low power, show a whorled arrangement of nerve fibres in the grey matter, but the loops are not complete, nor is direct association with centres demonstrated, the section evidently not having been made in a direction exactly parallel with any loop. The directions of the loops are various.

This chain of association of fibres forms a very intricate network, groups of nerve cells occurring at intervals at the points of intersection.

So far as I have been able to ascertain, this appearance has not previously been demonstrated, but is a new and hitherto undescribed feature of Meynert's "association system," viz., as it appears *within* a convolution, an *intra-gyral* system as distinguished from the *inter-gyral* association system described by him.

Right Occipital.—Average width of grey matter $1\frac{3}{4}$ millimetre. The pyramidal cells are few and small. Colloid bodies are much more numerous than the amyloid in the left, and are especially and extensively found in some parts of the white matter. The only other condition attracting observation is the evidence of old hæmorrhages of small size.

(b) *Left Ascending Frontal and Ascending Parietal* convolutions present appearances nearly similar. They show a fair condition of the grey matter as regards the nutrition of its elements. The pyramidal cells are larger and more numerous than in the occipital lobes, and their process better developed. The nuclei of the neuroglia are increased in amount, and the nerve fibres are few.

Right Ascending Frontal Convolution.—The grey matter shows little that is abnormal. Pyramidal cells and their processes larger and more numerous than on the left side. A number of large multipolar cells are seen, some exhibiting yellow granular degeneration. The white matter contains a large number of nerve fibres, some cut transversely and others running parallel with section.

(c) *Medulla Oblongata*.—Transverse sections were made at

various points above the decussation of the pyramids, and after staining with carmine, a macroscopic examination was made, and revealed the following conditions:—(1) The right anterior pyramid distinctly larger (about twice the size) than the left. (2) Opposite lower part of floor left corpus dentatum larger than right; but higher up the reverse obtained. (3) Opposite the lower part of the floor, the restiform and posterior pyramid are slightly larger on right side, the defect of the left posterior pyramid is, however, more apparent higher up. Microscopic examination shows yellow granular degeneration of many of the cells of the corpus dentatum, and of the multipolar cells in the floor of the fourth ventricle; these cells are not, however, extensively affected, and there is no evidence of cell-disintegration. At the same time the condition is more general, and involves the cell-substance to a greater extent than in the right ascending frontal. The effect of per-osmic acid was to blacken this yellow granular matter, indicating a fatty degeneration. Nerve fibres are relatively few in the left anterior pyramid; colloid bodies are present in the right and left, but the nerve fibres of the right are much more numerous than in the left anterior.

The leading features, then, of this case, briefly are—

I.—CLINICAL.

- (1) Mental defect coming under the definition of imbecility.
- (2) The faculty of memory not impaired, and that of speech childlike.
- (3) Paralysis of right arm and leg, with defective sensation of same side.
- (4) Convergent strabismus of right eye during life, and double convergent strabismus a few hours before death.

II.—PATHOLOGICAL. A. MACROSCOPIC.

- (1) Asymmetrical condition of cranium as regards (*a*) general contour, (*b*) thickness of bones, (*c*) size and form of the fossæ, and (*d*) vascular grooves.
- (2) The existence of three cysts—two containing clear serum—the other (smallest) bloody serum and fibrinous clot, the cyst walls formed by thickened arachnoid, and with an external covering of dura mater, but more or less free from these membranes in the floor of the two larger cysts. The absence of arachnoid at base of brain, and the presence of a bony growth in anterior part of falx cerebri.

- (3) Destruction of brain substance, chiefly affecting, to a greater or less extent, the following convolutions, &c.:—(a) transverse frontals, gyrus fornicatus, and marginal convolutions of right side, (b) middle and inferior temporo-sphenoidals, gyrus fornicatus, and quadrate lobule of left side, (c) corpus callosum.
- (4) Arrested development of the following convolutions:—(a) of left occipital lobe, (b) left ascending parietal and frontal, (c) left Island of Reil.
- (5) Complete dissociation of left occipital lobe from rest of hemisphere as regards continuity of nerve structure.
- (6) Asymmetrical development of (a) frontal convolutions, (b) parietals.
- (7) Arrested development of the following fissures:—(a) Left Sylvian, (b) left Rolando.
- (8) Feeble development of posterior and middle commissures of third ventricle, and of corpora quadrigemina.
- (9) Absence of Sylvian aqueduct.

B. MICROSCOPIC.

- (1) The comparatively healthy state and fair development of the nerve elements in left occipital lobe. (2) The intra-gyral association system demonstrated in the latter.
- (3) The right occipital lobe more extensively degenerated in its white substance than the left.
- (4) The deficiency of nerve fibres in left ascending convolutions, and their pyramidal cells relatively smaller and fewer than on the right side.
- (5) Degeneration of cells in ascending frontal (right), and corpus dentatum and floor of fourth ventricle in medulla oblongata.

C. MACROSCOPIC AND MICROSCOPIC COMBINED.

The projection system of Meynert showed defect on the left side as follows:—

- (a) Motor. Ascending frontal and parietal (macroscopic and microscopic) and parietal lobule. Corpus striatum (softening). Crura (diminished bulk). Anterior pyramid of medulla (macroscopic and microscopic).
- (b) Sensory. The occipital and part of temporal, &c. Optic thalamus (small size). Tegmentum (small). Posterior pyramid of medulla (small).

Remarks.—This remarkable case presents a collection of important features which are of interest in more than one department of medical science. To determine the possible, or most probable conditions which produced dissociation of the left occipital lobe is an interesting problem for the embryologist, and it is but one of many rudimentary conditions in this brain which may claim his attention. Here I would draw attention to the striking physiological fact that, without nerve connection, without function, in spite of the pathological influences in existence, and depending purely on the small strip of pia mater for its nutrition, this small lobe has, for 40 years, maintained, almost unimpaired, its integrity of nerve structure.

To the anatomist, the points of interest are numerous and varied; and they depend chiefly on the fact that this brain and cranium, in their physical appearances, constitute one mass of eccentricity. A *resumé* having already been given, I need not repeat them, but will merely refer to the additional fact of an intra-gyral system having been demonstrated in the left occipital lobe. This extension and elaboration of the association system demonstrates the exceeding complexity of nerve-structure in a single gyrus; and it suggests a corresponding complexity of function. The *inter-gyral* system enables us to understand how the groups of nerve cells in the *different* convolutions are connected functionally with each other: this *intra-gyral* system enables us to realize how the groups of cells in the *same* convolutions are so connected. But the question naturally presents itself—Why has this not been demonstrated before? Two possible explanations are suggested. (*a*) That in so small and simple a lobe the meshes or loops are necessarily small, and thus escape division by the section knife more readily than in the fully-developed structure, where they are considerably larger. (*b*) That at the comparatively early stage of development reached by this lobe, the intra-gyral system is so much simpler in its arrangement than in the fully-developed lobe, that it is demonstrated more clearly and intelligibly. A microscopic study of a gyrus in course of development, like that of other parts, may be expected to throw additional light on its structure.

But the question which is brought most prominently before us in the investigation of this case is its bearing on the problem of the localization of the cerebral functions. Does it contribute anything to a solution of the problem, and to what extent? The former part of the question may safely

be answered in the affirmative ; but the latter cannot receive so definite a reply. The present state of our knowledge will not permit us to utilise the facts here presented to the full extent of their possible future bearing on the question. The rudimentary condition (shown in the macroscopic and microscopic appearances) of the left ascending convolutions, the small size of the parietal lobule, extensive disease of left corpus striatum, and the defect of the motor division of the projection system therefrom downwards through the crus and medulla, combined with the clinical fact of congenital right hemiplegia, afford strong evidence in favour of the belief that the convolutions above-mentioned are associated with the motor supply of the arm and leg.

The relatively small size on the left side of the optic thalamus, tegmentum of crus, and posterior pyramid of medulla, the dissociation of left occipital lobe, and destruction of part of left temporo-sphenoidal, combined with defective sensation of right side, appear to harmonise with the principal distribution of sensory fibres, as given by Meynert, a distribution which Ferrier, however, disputes.

We meet, however, with the most difficult part of the problem, when we come to consider how far the pathological conditions and mental symptoms, taken together, can throw light on the question of localisation. There is still doubt as to the part played by the hemispheres respectively in psychical manifestations. Some observers even hold that, so far as mentalisation is concerned, one hemisphere is sufficient. Now this is contrary to what *à priori* we would look for ; and not only so, but it is not in keeping with carefully observed pathological and clinical conditions. In his work on "The Functions of the Brain," 1876, Dr. Ferrier refers to the "American crow-bar case," as illustrating the fact that disease or injury of the præ-frontal region of one hemisphere is not followed by any appreciable mental symptoms. In his more recent work, "The Localisation of Cerebral Disease," 1878, Ferrier furnishes a detailed account of this case, as given by Dr. Harlow at a later period. Dr. Harlow reports a decided change in the patient's mental state, from being that of a man having a well-balanced mind, and considerable business energy and capacity, to that of a child, as regards his intellectual capacity and manifestations, &c. That case, with many others, had been quoted, to show that one lobe may be seriously affected without mental symptoms.

At this point I would quote a remark of Dr. Ferrier's, with

regard to the observation of mental symptoms in bilateral cerebral lesions, as it is equally pertinent to the question now under consideration, viz., unilateral lesions:—"Unless a man becomes so demented as to neglect the ordinary wants of nature; or so furious, maniacal, or irrational as to require restraint, there are few engaged in the practice of medicine who think of enquiring narrowly into a patient's mental state; and, even if more attention were directed towards this subject, are we in possession of any means of accurately gauging the mental condition of an individual, so as to be certain that it has altogether escaped damage, notwithstanding the presence of a cerebral lesion." There can be no doubt that psychological investigations are frequently neglected or slurred over, and so long as some medical men resort to the brief and unsatisfactory report of "no mental symptoms," I do not consider their evidence is of much value. So long as they do not intelligently enquire into the condition of the leading attributes of mind, compare present with previous mental manifestations, and state in detail positive and negative features, so long must we grope our way blindly in the matter.

R.'s case, and the "crow-bar case" agree physically as follows:—(a) In that the proper relation of the hemispheres to each other was, to some extent, broken; in the former case from commissural defect, in the latter from left præ-frontal lesion; (b) in that the *inter-gyral* system of association was not entire in the left hemisphere, in the former case, from dissociation of the occipital lobe, and deficiencies in some convolutions, in the latter from the præ-frontal lesion. In R.'s case, this want of relation was much greater than in the other; and there was deficiency also in right præ-frontal region.

They agree mentally in this general point, that there was imbecility, but differ as regards the moral character and emotions. Gage, in his changed mental condition, showed a striking want of inhibitory exercise, a marked predominance of evil impulses, self-direction which wanted intelligent guidance and control, and considerable moral depravity. R.'s condition, less positive in its character, exhibited less need for inhibited influence, a freedom from evil impulses, deficiency of self-direction other than of a passive nature, a reverence for moral laws, and emotions forming a decided contrast with those in Gage's case.

Regarding the simplicity of Broca's convolution, and the

left island of Reil, compared with the corresponding points of the right side, I would remark that the simplicity of R.'s expressions, and his limited vocabulary, were quite in keeping with these conditions. At the same time it may be contended that their larger size and better development on the right side, combined with the fact that he was practically left-handed (having been congenitally hemiplegic on the right side), argue strongly in favour of the speech-centre having been seated in the right hemisphere.

In considering the mental capacity of R. in view of the pathological conditions described, we have to keep in mind at least four facts, (*a*) extensive destruction of right præ-frontal region, (*b*) simplicity of arrangement of gyri of left præ-frontal region, (*c*) loss of commissural fibres, (*d*) defective condition of motor and sensory areas on the left side, and corresponding deficiency of association fibres. What influence these conditions respectively had on his mental development, is a question which cannot yet be determined with certainty. This strange brain, prolific as it is in suggestions of various kinds, must wait its time for further explanations on these points.
